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Agricultural Implications of Natural Gas Deregulation

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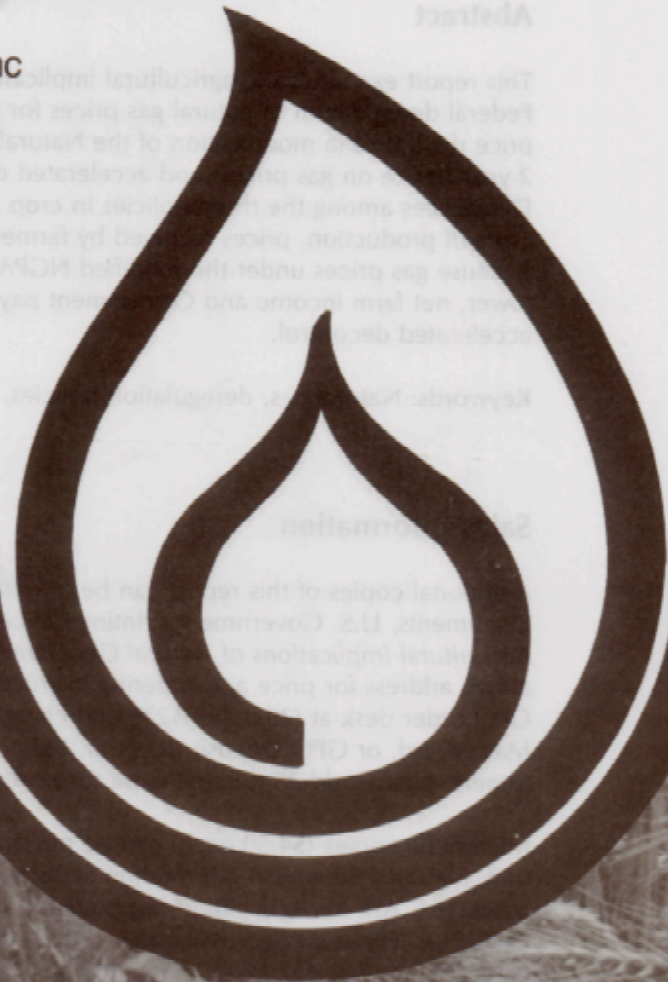
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Abstract

This report examines the agricultural implications of three policy options for Federal deregulation of natural gas prices for the period 1983-90: a phased-in price decontrol (a modification of the Natural Gas Policy Act of 1978 (NGPA)); 2-year freeze on gas prices; and accelerated decontrol of wellhead gas prices. Differences among the three policies in crop and livestock production, variable costs of production, prices received by farmers, and net farm income are minor. Because gas prices under the modified NGPA and price freeze policies are lower, net farm income and Government payments would be higher than under accelerated decontrol.

Keywords: Natural gas, deregulation policies, agricultural implications.

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Summary

The effects of three alternative natural gas price options on agriculture, ranging from postponed decontrol to accelerated decontrol, would differ little in the long term despite agriculture's dependence on natural gas.

This report explores three alternatives—not specific proposals, but illustrations of a broad range of options being considered—to the phased deregulation of natural gas prices required by the Natural Gas Policy Act of 1978 (NGPA):

- A modified phased-in decontrol option would allow gradual deregulation of natural gas over a 7-year period (1983–90 in this study). This gradual phasing in of higher prices would lessen the price inflation which would result from immediate decontrol.
- A price freeze option would call for a 2-year postponement of price decontrol which had been scheduled under the NGPA. A phased decontrol would then begin, which would postpone the effects of price inflation.
- An accelerated decontrol option would completely deregulate natural gas prices within 36 months. It would be accompanied by a 35-percent tax on the increased profits suppliers could earn by charging higher prices on older, less expensively produced natural gas. Price inflation would be fastest in this option.

In any of the options, the greatest effect on agricultural production would be on the manufacturing of nitrogen fertilizer. Natural gas accounts for about 70 percent of the variable costs of producing ammonia, the principal ingredient of nitrogen fertilizer. But the effect on fertilizer prices would be minimal since only about 20 percent of any increase in natural gas prices is normally passed through fertilizer prices if there are no restrictions on fertilizer imports.

The agricultural sector would not be significantly affected by either accelerated decontrol or a 2-year freeze on natural gas prices. Total net farm income over the 1983–90 period would be 2 percent less under accelerated decontrol than under the modified phased-in decontrol option. In any given year, the differences among the three policy options on crop and livestock production, variable production costs, and prices received by farmers would be generally less than 2 percent. Accelerated decontrol would cause a slight decrease in food grain, feed grain, and fiber production compared with the other two options, reflecting a shift from corn and cotton to crops requiring less fertilizer, such as soybeans.

Government payments to agriculture would be slightly lower for the accelerated decontrol option than for the other two options. However, net farm income would also be lower. By 1990, there would be only minor differences among the scenarios.

Each of the alternatives would ultimately result in higher natural gas prices. These higher natural gas prices, however, would have only a small negative effect on disposable income and only a small negative effect on food demand.

Glossary

Contract Prices. When used with respect to any specific date,

- (1) the price paid, per million British thermal units (Btu's), under a contract for deliveries of natural gas occurring on such date; or
- (2) if no deliveries of natural gas occurred under such contract on such date, the price, per million Btu's, that would have been paid had such deliveries occurred on such date.

Existing Contract. Any contract for the first sale of natural gas in effect on the day before the date of the enactment of the Natural Gas Policy Act of 1978 (NGPA).

Favored Nations Clause. A provision in the Gas Purchase Contract increasing the price to be paid for natural gas by a purchaser to the seller-producer if any producer in the field receives a higher price than that stipulated in the contract. An example of such a clause is:

"If at any time or time subsequent to the date of execution of the contract, Buyer shall enter into a contract providing for the purchase of gas in [names of counties in which the field is located] at a price per 1,000 cubic feet higher than the price per 1,000 cubic feet payable at the same time hereunder and for gas of a similar character taken under similar conditions of delivery, pressures, reservations, or life or term of contract, then Buyer will increase the price of gas thereafter received hereunder so that it will equal the price payable at the same time under such other contract."

A two-party favored nations clause provides that if the buyer purchases gas in the same field or area at a higher price than is paid under the contract in question, the buyer must thereafter pay to seller the same price the buyer is paying to other sellers. A third-party favored nations clause provides that the buyer will pay seller a price equal to the highest price paid by any buyer or seller.

Indefinite Price Escalator Clause. Includes any provision of any contract

- (1) which provides for the establishment or adjustment of the price of natural gas delivered under such contract by reference to other prices for natural gas, for crude oil, or for refined petroleum products; or
- (2) which allows for the establishment or adjustment of the price of natural gas delivered under such contract by negotiation between the parties.

Interstate Pipeline. Any person or firm engaged in natural gas transportation subject to the jurisdiction of the Federal Energy Regulatory Commission (FERC) under the Natural Gas Act.

Intrastate Pipeline. Any person engaged in natural gas transportation (not including gathering) which is not subject to the jurisdiction of the Federal Energy

Regulatory Commission under the Natural Gas Act (other than any such pipeline which is not subject to the jurisdiction of the Commission solely by reason of section 1(c) of the Natural Gas Act).

Long-Term Contract. Often arranged in order to guarantee continued service and to justify capital investments in either gas turbines or pipelines. Contracts in the interstate market were historically written for 20 years or more. Long-term contracts also exist in the major intrastate markets, such as Texas and Louisiana. Recent contracts are for shorter time periods, reflecting producers' fears of being locked into fixed prices during inflationary periods. Thus, while the gas market is beginning to acquire more flexibility, the existence of long-term contracts will delay the adjustment of the gas market to new gas pricing policies.

New Contract. Any contract, entered into after 1978 (the date of the enactment of the NGPA), or the first sale of natural gas that was not previously subject to an existing contract.

Present Value. The future payments due discounted back to the present date at an assumed interest rate.

Section 107 Gas. Gas which is costly to produce including gas from wells drilled below 15,000 feet and gas produced from geopressured brine, coal seams, and Devonian shales.

Take-Or-Pay Provisions. Take-or-pay provisions require the buyer to pay for certain quantities of gas at preset prices regardless of whether delivery occurs at the time of payment. The financial uncertainty associated with gas production is a major motivation for this provision. Because of the large cash investments required to drill and develop a well, producers often need payment for large amounts of gas during the first few years of a contract. These requirements lead producers to seek an assured market for their gas, through contracts tied to the production from a specific well or a particular field. Take-or-pay provisions are also sought by producers for protection against situations in which pipelines or other buyers could exert a disproportionate influence on prices and quantities sold once gathering equipment is in place.

Windfall Profits Tax. Tax on profits derived from natural gas that would be produced without deregulation.

Agricultural Implications of Natural Gas Deregulation

Michael LeBlanc, Thomas Lutton, Tony Prato,
and Gary Reisner

Introduction

The United States continues its search for an orderly way to end 25 years of Federal regulation of natural gas prices. The Natural Gas Policy Act of 1978 (NGPA) initiated phased deregulation of natural gas prices. However, inherent limitations of the act and certain provisions in long-term gas contracts have contributed to disarray in natural gas markets. The least costly natural gas resources are not being developed first, significant price differences exist among various categories of natural gas, and "take-or-pay" clauses (see Glossary) in contracts between gas producers and distributors are contributing to rapid growth in gas prices despite what appears to be an oversupply of gas.

In an attempt to lessen or eliminate these and other difficulties, Congress has considered several amendments to the NGPA. The debate regarding these amendments is controversial because the economic benefits and costs of gas-price deregulation are likely to be unevenly distributed among gas producers, distributors, and consumers in different regions. Deregulation of natural gas prices is important to agriculture because a continued increase in gas prices is likely to increase fertilizer prices, irrigation costs, and crop-drying expenses, thereby raising food production costs. Moreover, gas-price increases will probably reduce real disposable income and, hence, lower national food demand.

This report evaluates potential economic effects of natural gas pricing-policy options on agricultural production, prices, and income. The report also analyzes the effect of these options on the ammonia industry. The deregulation options which this report analyzes do not represent specific proposals or policy options. Rather, the policy options evaluated here encompass a broad range of options proposed or being discussed.

Public Regulation of Natural Gas Prices

Regulation of natural gas began with the Natural Gas Act of 1938 (NGA) which authorized the Federal Power Commission (FPC) to regulate prices charged by

interstate pipeline companies.¹ These interstate pipeline companies transport gas to industrial consumers and gas distributors (mainly utilities) located outside the producing State. Because an interstate market is usually served by only one pipeline, the pipeline company has a monopoly in that market. Thus, Congress determined that interstate gas prices should be regulated. FPC did not regulate prices charged by intrastate companies, which transport gas within the State in which it is produced.²

From 1938 to 1954, the FPC interpreted the NGA to exclude regulation of wellhead prices of natural gas. Wellhead prices are the prices which pipeline companies pay to gas producers. However, a 1954 Supreme Court decision (Phillips Petroleum Company vs. Wisconsin) resulted in FPC regulation of wellhead prices of natural gas sold in interstate markets.³ Prices charged by gas utilities are regulated by State-level public commissions.

Because of wellhead price controls on interstate gas and the absence of similar controls on intrastate gas, interstate gas producers received lower prices than did intrastate gas producers. From 1973 to 1977, average real prices for intrastate gas increased at a faster rate than did interstate gas prices. One consequence of this price disparity is that reserves in the interstate lower-48 onshore market declined from 1968 to 1975 and shortages occurred in interstate markets during the mid-seventies. In 1976, interstate pipeline companies received some relief from their disadvantaged position when the FPC tripled the maximum wellhead price for new interstate gas. From 1976 to 1979, net reserves in the interstate market steadily increased.

The Natural Gas Policy Act of 1978 made major changes in the public regulation of wellhead gas

¹Richard P. O'Neill, "The Interstate and Intrastate Natural Gas Markets," *Monthly Energy Review*, DOE/EIA-0035(82/01), January 1982.

²The States of Kansas, Oklahoma, and New Mexico regulate the prices of intrastate gas.

³The Department of Energy Authorization Act of 1978 abolished FPC and transferred its regulatory authority to the Federal Energy Regulatory Commission (FERC).

prices. The major objectives of the NGPA were (1) to eliminate the price and supply disparities between wellhead prices in the inter- and intrastate markets; (2) to establish a schedule for phased decontrol of wellhead prices of "new" natural gas (gas produced after April 1977); and (3) to shield residential and selected industrial gas customers from a rapid increase in natural gas prices. The NGPA extended wellhead price controls to the intrastate market to reduce the price disparities between inter- and intrastate gas. Gas was separated into 28 separate categories based on the date of initial production, well depth, and geographic location. These categories have different prices, price-escalation maximums, and dates of final decontrol. Under the NGPA, approximately 50 percent of domestic natural gas will be decontrolled by January 1985.

The NGPA has been a major factor in natural gas price increases since 1978. Average wellhead prices rose from \$0.91 per 1,000 cubic feet (MCF) in 1979 to \$2.41/MCF in 1982. Since 1977, average wellhead gas prices increased by \$0.38/MCF per year. Residential gas prices increased from \$2.63/MCF in 1978 to \$5.48/MCF in 1982 (over 100 percent) with an annual average increase of \$0.71/MCF. This annual increment is almost twice that which occurred in each of the 4 years prior to the NGPA.

As a result of the NGPA, a wide range of ceiling prices exists for regulated gas. In 1983, ceiling prices ranged from a low of \$0.28/MCF for minimum-cost gas to a high of \$5.48/MCF for "Section 107" gas. In addition, deep gas (greater than 15,000 feet) has sold for \$10/MCF, over twice the British thermal unit (Btu) equivalent price of No. 6 residual fuel oil, the primary substitute for natural gas in industrial uses. If world oil prices continue to decline through 1985, as forecast by the U.S. Department of Energy (DOE), and gas prices continue to increase as they have under the NGPA, the average wellhead price of gas would be close to residual fuel oil prices by 1985.⁴

A contributing factor to the recent escalation in gas prices is the "take-or-pay" clauses found in contracts

between gas producers and pipeline companies negotiated in the 1976–80 period. This clause requires the pipeline company to pay for a specified volume of gas whether the company has customers for this gas or not. Take-or-pay clauses were popular during the mid-seventies when shortages of natural gas reduced the ability of interstate companies to meet the high demand for gas. To reduce the risk of future gas shortages, interstate companies agreed to take-or-pay clauses. Take-or-pay clauses in combination with the higher wellhead prices for deep and decontrolled gas have encouraged the exploration for and development and marketing of higher cost gas reserves at the expense of lower cost gas reserves.

Alternatives to Current Policy

As of mid-1983, the NGPA had not achieved its intended objectives. Differentiating a homogeneous product such as natural gas into 28 categories has led to wide disparities in natural gas prices. In 1981, wellhead prices ranged from under \$1/MCF for old gas to \$10/MCF for unregulated deep gas. Despite the NGPA, supply and price disparities still exist in the inter- and intrastate markets. Pipeline companies charge their consumers a price based on the average cost of purchased gas. Interstate companies control large quantities of lower priced old gas; therefore, they can "roll-in"—combine—higher cost new gas with lower priced old gas and still maintain consumer prices that are competitive with those charged by intrastate companies serving the same market area. Whereas intrastate companies could outbid interstate companies for new gas supplies prior to passage of the NGPA, the reverse is true in the post-NGPA period.

Incremental pricing, established by the NGPA as a way of sheltering residential and agricultural gas customers from the price escalation due to phased decontrol of new gas, does not appear to be working. Price sheltering was to be accomplished by requiring "nonexempt" industrial users to pay a larger share of price increases for deregulated gas than exempt users. Incremental pricing has been ineffective as a price shelter because there has been a substantial reduction in industrial consumption of natural gas (18 percent since 1978) thereby making the volume of nonexempt industrial gas purchases small relative to total gas use. Industrial gas consumption declined as a result of higher gas prices and the recession.

⁴A recent midrange DOE forecast shows real world oil prices at \$25/barrel (bbl) in 1985 (1982 dollars). The current world oil price is about \$29/bbl. U.S. Department of Energy, Energy Information Administration, *Synopsis of the Annual Energy Review and Outlook-1982*. DOE/EIA-0385(82). April 1983.

The decontrol schedule for new gas set in 1978 by the NGPA is based on a 1985 oil price of \$15 per barrel (in 1978 dollars). In 1979, world oil prices increased 50 percent and real 1985 oil prices of \$30 per barrel (bbl) were forecast.⁵ The difference between \$30/bbl and \$15/bbl raised the possibility of a large increase in average gas prices in 1985. The extent of this increase, however, has been considerably reduced with recent drops in crude oil prices.

Since 1981 various members of Congress have introduced a series of bills to address inadequacies in the NGPA gas price formulas. In the spring of 1983, for example, there were at least five bills introduced in the Senate and seven in the House of Representatives which dealt with natural gas policy.⁶ The bills ranged from a wellhead gas-pricing policy which delays NGPA to accelerated decontrol. The bills contrast with each other by providing for wellhead price freezes, modified wellhead price escalation tied to inflation rates, and immediate price decontrol.

Also in 1981, Representative Phil Gramm introduced a bill calling for a constant percentage increase in gas prices up to a reference price until January 1985. The reference price, to be adjusted semiannually, is the wholesale price of No. 6 residual fuel oil. This bill called for immediate removal of the Purchased Industrial Fuel Use Act restrictions and decontrol of all gas prices after 1985.

In February 1983, the Reagan administration proposed a new policy to deregulate natural gas prices. The major provisions of this policy are as follows:

- Prior to January 1, 1986, new contracts renegotiated by mutual agreement of gas producers and pipeline companies would be deregulated; that is, they would be exempt from the NGPA price controls. After January 1, 1986, either party could abrogate the contract.
- Gas prices that remain subject to regulation would be limited to the lesser of the NGPA ceiling

price or a new floating cap set equal to the average price of gas purchased through renegotiated and new contracts. Prices of gas not currently regulated could not exceed the floating cap unless contracts were renegotiated prior to January 1, 1986.

- All gas would be deregulated by January 1, 1986.
- Take-or-pay provisions would be limited, allowing pipelines to refuse payment for volumes exceeding 70 percent of contracted gas.⁷
- Incremental pricing would be repealed and automatic pass-through of purchased gas adjustments (escalator clauses) in contracts that were not renegotiated would be limited to the rate of inflation unless FERC determined that a greater increase was justified.

While this proposed policy has several objectives, its main purpose is to achieve a more orderly transition to a deregulated natural gas market. The most controversial aspect of this policy is the deregulation of old gas. Because the average cost of producing old gas is considerably below the expected average price of unregulated gas, pipeline companies with large quantities of old gas would reap substantial windfall profits. For this reason, some members of Congress have proposed to add a windfall profits tax on old gas to the administration's bill.

Agricultural Use of Natural Gas

Agricultural production accounts for about 3 percent of the energy consumed in the United States. Direct and indirect use of natural gas constitutes nearly half of all energy used in agricultural production. Agriculture uses about four times more natural gas indirectly through fertilizer than through direct use of irrigation and crop drying.⁸ Natural gas accounts for about 70 percent of the variable costs of producing ammonia,

⁵In 1981, DOE estimated that the average wellhead price of natural gas would increase from \$2.61/MCF in 1984 to \$4.45/MCF in 1985 when deregulation of new gas is completed. U.S. Department of Energy. *A Study of Alternatives to the Natural Gas Policy Act of 1978*. DOE/PE-0031, November 1981.

⁶U.S. Department of Energy. *The Natural Gas Market Through 1990*. DOE/EIA-0366, May 1983.

⁷A reduction in the take-or-pay percentage gives pipeline companies greater flexibility to adjust their purchases to short-term variation in demand and lowers their average cost of gas.

⁸W. Tyner, O. Doering, and V. Eidman. "Natural Gas Deregulation: Its Impacts on Agriculture." Paper presented at the American Agricultural Economics Association meetings, Logan, Utah, August 1982.

Table 1—Natural gas and fertilizer use in agricultural production by region, 1980

Region	Natural gas ¹	Fertilizer ²
	Trillion Btu	1,000 tons
Northeast	1	927
Lake	7	2,700
Corn Belt	8	8,022
Northern Plains	18	2,647
Appalachia	1	1,719
Southeast	1	1,940
Delta	4	1,905
Southern Plains	35	1,610
Mountain	14	867
Pacific	5	1,580
U.S. total	93	22,917

¹David Torgerson and others. *Energy and U.S. Agriculture: State and National Fuel Use Tables, 1978, 1980, and 1981*. U.S. Department of Agriculture, Economic Research Service, AGES 840505. June 1984.

²U.S. Department of Agriculture, Economic Research Service. 1981 *Fertilizer Situation*. FS-11. December 1980.

the principal ingredient of nitrogen fertilizer. Over 30 MCF of natural gas are required to produce 1 ton of ammonia.

Primary direct uses are for pumping irrigation water in the West and Southwest and crop drying in the Midwest.⁹ The Southern Plains region (Texas and Oklahoma) uses 35 billion cubic feet of gas or 38 percent of agriculture's direct use of natural gas primarily for irrigation (table 1). Expenditures on direct uses constitute about 3.5 percent of farm energy expenditures but only 0.2 percent of total farm expenses.¹⁰

The regional effects of higher natural gas prices will likely dissipate over time as more fuel efficient irrigation technologies and natural gas substitutes are adopted. The magnitude of the effects of higher natural gas prices on national crop production costs and the mix of crops produced depend largely on the extent to which higher natural gas prices are passed through to fertilizer prices and the elasticity of demand for fertilizer.

The food processing industry is a large user of natural gas. Almost 60 percent of the energy used to process food is derived from natural gas.¹¹ This figure varies regionally. For example, in the Western United States, natural gas supplies almost 80 percent of all food-processing energy. However, natural gas expenditures account for less than 0.5 percent of food-processing production costs.¹² The use of natural gas in food processing varies according to food type. Dairy, meat, and fruit and vegetable processing derive over 63 percent of their energy needs from natural gas. Grain milling, baking, and sugar and confectionary manufacturing industries derive less than 40 percent of their energy requirements from natural gas.

The predominant use of natural gas in the food-processing industry is for process heat in boilers. Since boilers can be fired with many other fuels, the food-processing industry could shift to other fuels as natural gas prices increase. Although food processors will not experience a shortage of fuels for heating, they will lose the benefits of artificially low natural gas prices when gas is totally decontrolled.

Method of Analysis and Assumptions

Natural gas price increases affect agriculture by increasing production costs and decreasing the demand for agricultural products. Increases in agricultural production costs occur primarily from higher fertilizer prices and secondarily from increases in irrigation and crop-drying costs. Lower demand for agricultural products results from the depressing effect of higher natural gas prices on real disposable personal income. The three natural gas deregulation options selected for analysis are identical to those examined by Wharton Econometric Forecasting Associates (WEFA).¹³ WEFA estimated the macroeconomic effects of three policy options using their macroeconomic forecasting model. Fertilizer price forecasts for each of the three Wharton gas-price policy options were determined by inserting each gas-price scenario into a two-equation econometric model of fertilizer prices and imports.

¹¹James Bierlein. *Seasonal and Regional Variation in Energy Use by U.S. Food Processors*. Agricultural Experiment Station Bulletin No. 838. Pennsylvania State University, January 1982.

¹²T. Lutton and M. LeBlanc, "A Comparison of Multivariate Logit and Translog Models for Input Demand Studies," *Energy Journal*, (Forthcoming 1984).

¹³Wharton Econometric Forecasting Associates. *The Wharton Long-Term Forecast: Alternative Scenarios*. Philadelphia, January 1983.

⁹Although no current estimates are available, Tyner, Doering, and Eidman (1982) estimated that approximately 27 billion cubic feet of natural gas were consumed by local and regional grain elevators to dry grains in 1974. This quantity has increased in the last 9 years, thus increasing the potential adverse effects of higher gas prices on Midwest farmers.

¹⁰U.S. Department of Agriculture, Statistical Reporting Service. *Farm Production Expenditures for 1980*. Sp5y5 (7-81). July 1981.

The WEFA model assumes that deregulation causes Btu price parity between natural gas and residual fuel oil, except when prevented by price ceilings. To determine the effects on agriculture of the three gas deregulation policy options, Wharton's macroeconomic forecasts of disposable personal income, nonfood Consumer Price Index, wages, short-term interest rates, and oil prices plus the fertilizer price forecasts (app. A) were incorporated into the USDA Food and Agricultural Policy Simulator model (FAPSIM).¹⁴

Concern over rising prices of natural gas and efficient development of gas resources has led to several proposals to modify the NGPA and other contractual arrangements between gas producers and pipeline distributors. Since new legislation undoubtedly will combine elements of alternative legislative proposals, the final legislation will not necessarily conform to any of the three options analyzed in this report. Nevertheless, the two non-NGPA options analyzed here are extreme cases encompassing a wide range of variation in natural gas prices. As such, the range of agricultural effects from the policies are likely to encompass the actual effects of any new legislation.

Modified NGPA Option

This scenario modifies the NGPA to allow for gradual deregulation of new gas between 1985 and 1987 and a reclassification of old gas between 1987 and 1990 (fig. 1). Total deregulation of all natural gas would not be achieved until 1990. A gradual phase-in of higher prices reduces the potential shock to the economy of immediate decontrol in 1985.

Price Freeze Option

In 1982, Senator Thomas F. Eagleton introduced legislation that would postpone for 2 years the scheduled price decontrol of natural gas under the NGPA. Well-head gas prices would be frozen from July 1, 1983, to July 1, 1985. From July 1, 1985, to December 31, 1986, price increases would match the modified NGPA schedule from the previous 2 years. Phased decontrol of all gas, except old interstate gas, would be allowed from 1987 to 1990.

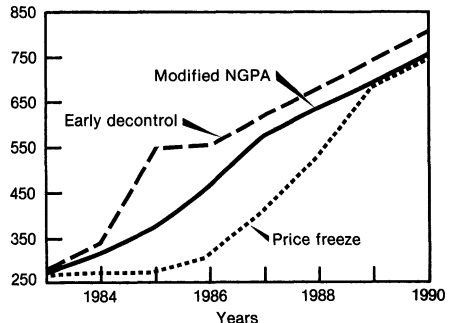
A simple freeze would postpone inflation adjustments in the ceiling price of each gas production category. Even when ceiling prices are frozen, the average well-head price of natural gas could continue to rise if utility purchases of inexpensive natural gas decline further.

Accelerated Decontrol Option

Proponents of the accelerated decontrol policy argue that because many contract prices are tied to price ceilings determined by the NGPA, removing these ceilings will force many contracts to be renegotiated, thus voiding problematic take-or-pay clauses. Excess supplies would exert downward pressure on new contract prices. However, inexpensive reserves of gas are assumed to be insufficient to stop natural gas prices from moving toward delivered-price parity with No. 6 residual fuel oil. Based on the recent experience with respect to crude oil, the accelerated decontrol option is assumed to be accompanied by a windfall profits tax on the natural gas industry. By increasing both corporate income taxes from natural gas producers and personal income taxes, accelerated decontrol with a windfall profits tax offers the prospect of significantly reducing the Federal deficit in the Wharton analysis.

The specific accelerated decontrol policy option analyzed here requires decontrol of wellhead prices over 36 months beginning July 1, 1983. As old gas is decon-

Figure 1
Alternative Natural Gas Prices, 1983-90
Cents per MCF



¹⁴ L. Salathe, M. Price, and K. Gadson. "The Food and Agricultural Policy Simulator." *Agricultural Economics Research*, Vol. 34, No. 2 (April 1982), pp. 1-15. FAPSIM is an econometric model of the agricultural production sector.

trolled, a 35-percent windfall profits tax would be imposed on all natural gas.

Macroeconomic Effects

Each of the natural gas policy options analyzed would result in different rates of growth and timepaths for GNP, interest rates, wages, inflation, and other macroeconomic variables (table 2). The differences in macroeconomic conditions would be most significant in the 1984–86 period. By the end of the decade, natural gas prices would not differ significantly; consequently, macroeconomic conditions would be roughly the same.

Macroeconomic forecasts under the modified NGPA reflect an underlying weakness in near-term economic prospects with large Federal deficits, high unemployment, a strong dollar, and continued poor corporate liquidity. General economic conditions would improve in 1984 with real gross national product (GNP) growth at 5 percent and fixed investment increasing by 20.5 percent in 1984. Consumer spending on durable goods would increase, and interest rates would decline from 12 percent in 1983 to about 9 percent in 1990 in response to a more accommodating monetary policy, falling inflation rate (6.1 percent in 1983 to 4.7 percent in 1990), and declining Government deficits. Unemployment and inflation are also projected to decline throughout the eighties.

The modified NGPA policy is compatible with a general improvement in the agricultural sector. Food demand is stimulated domestically by increases in disposable personal income and internationally by a weakening in the value of the dollar relative to other currencies. Although natural gas and fertilizer prices would increase, the high growth rate in other input prices which occurred during the last decade is expected to abate. In the given Wharton model results, both the general inflation rate as measured by the GNP deflator and the growth in wages are projected to decline from 1983 to 1990. Although farm credit problems may ease as nominal interest rates decline from 12.15 percent in 1983 to 8.9 percent in 1990, the real interest rates would remain high.

From a macroeconomic perspective, the price freeze option trades near-term growth for higher long-term inflation and slower growth. During the 1983–88

period, a price freeze would result in a higher real GNP than the modified NGPA option by \$48.5 billion. In 1989, real GNP under the price freeze would be \$5.3 billion lower than under the modified NGPA. Inflation, as shown by the GNP deflator, would be greater for the modified NGPA option than for the price freeze option until 1988 when it would be 0.5 percent lower. Wage rates would display a similar pattern when lagged by one period. There are only moderate differences between the interest rates for the three policy options considered.

During the 1983–85 period, natural gas prices would be 13 percent lower, inflation 0.4 percent lower, and GNP growth 0.2 percent higher under the price freeze option than under the modified NGPA option. However, when decontrol finally occurs, the effects of the price freeze option would be much greater than for the modified NGPA option. Natural gas prices would increase 135 percent from 1986 to 1990 and the inflation rate for the price freeze would be about 0.4 percent higher than for the modified NGPA option from 1988 to 1990.

The accelerated decontrol option assumes phased-in decontrol of gas prices and a tax of 35 percent on the resulting windfall profits. Significant differences exist in both the magnitude and timing of effects relative to the modified NGPA and price freeze policy options. By 1985, the price of natural gas under accelerated decontrol would be 45 percent higher than for the modified NGPA and nearly 100 percent higher than for the price freeze option. Inflation would be higher by 0.6 percent in 1985, and real GNP would be \$11 billion lower for accelerated decontrol than for the modified NGPA.

With accelerated decontrol, the Federal deficit would decrease by a net \$55 billion from 1983 to 1985. The 1985 unemployment rate would be 0.3 percent higher than for the modified NGPA, and unemployment benefits would increase \$2 billion under accelerated decontrol. Total Government outlays would be \$13 billion higher in 1985 for accelerated decontrol than for the modified NGPA option. In 1990, Federal receipts would be about \$36 billion more for accelerated decontrol than for the price freeze option and \$16 billion more than for the modified NGPA option.

The effects of the three price policies are difficult to compare because the time streams for the macroeco-

conomic variables differ. Comparing the sum of real GNP over the 1983-90 period does not provide a good measure of relative benefits of the three policies because it ignores the time value of money. For

example, the accelerated decontrol option trades early increases in inflation and interest rates for greater long-term prosperity; the price freeze option does the opposite. For this reason, the three pricing policies are

Table 2—Macroeconomic effects of alternative natural gas-pricing options

Selected indicators	1983	1984	1985	1986	1987	1988	1989	1990
<i>Billion 1972 dollars</i>								
Gross national product:								
Modified NGPA	1,527.7	1,604.3	1,663.4	1,695.4	1,756.6	1,814.5	1,862.9	1,899.0
Price freeze	1,527.8	1,607.1	1,671.2	1,709.4	1,822.9	1,822.9	1,857.6	1,884.3
Accelerated decontrol	1,527.4	1,602.7	1,652.9	1,683.8	1,748.4	1,814.7	1,869.8	1,905.2
Disposable personal income:								
Modified NGPA	1,096.5	1,130.6	1,162.0	1,185.4	1,227.4	1,265.1	1,293.4	1,317.2
Price freeze	1,096.7	1,133.9	1,169.0	1,195.4	1,237.0	1,268.5	1,288.2	1,308.7
Accelerated decontrol	1,096.3	1,128.6	1,152.2	1,179.1	1,224.7	1,265.3	1,296.2	1,320.0
<i>Percent</i>								
Change in GNP deflator:								
Modified NGPA	5.9	6.3	6.8	6.7	5.9	4.9	4.7	3.7
Price freeze	5.8	5.8	6.2	6.3	5.7	5.4	5.4	4.8
Accelerated decontrol	5.9	6.5	8.3	6.0	5.6	5.6	4.8	4.7
Unemployment rate:								
Modified NGPA	9.67	8.88	8.12	8.30	7.80	7.27	7.03	6.8
Price freeze	9.67	8.79	7.87	7.82	7.21	6.84	7.03	7.2
Accelerated decontrol	9.68	8.93	8.45	8.70	8.20	7.43	6.88	6.5
Change in wage rate:								
Modified NGPA	7.2	8.5	9.3	8.7	8.1	6.4	5.7	5.7
Price freeze	7.2	8.3	8.9	8.3	7.9	6.6	6.1	5.8
Accelerated decontrol	7.2	8.7	10.2	8.5	7.9	6.2	5.8	6.1
Short-term interest rate:								
Modified NGPA	12.15	10.66	10.01	9.66	9.59	9.48	9.23	8.9
Price freeze	12.15	10.56	9.73	9.22	9.08	9.13	9.21	9.1
Accelerated decontrol	12.16	10.72	10.36	10.06	9.86	9.56	9.14	8.8
<i>Billion current dollars</i>								
Government expenditures:								
Modified NGPA	810.8	877.2	950.8	1,035.3	1,120.2	1,206.2	1,301.1	1,398.8
Price freeze	810.6	873.9	941.7	1,019.3	1,099.6	1,188.8	1,293.5	1,398.6
Accelerated decontrol	811.1	879.0	963.5	1,047.2	1,047.2	1,131.1	1,304.9	1,400.0
Government receipts:								
Modified NGPA	650.0	741.7	834.1	921.4	1,026.3	1,119.8	1,211.7	1,324.3
Price freeze	649.7	736.1	824.3	910.3	1,012.5	1,108.5	1,200.4	1,304.5
Accelerated decontrol	650.7	745.0	857.6	926.0	1,031.1	1,131.3	1,229.4	1,340.1
<i>Current cents per million cubic feet</i>								
Natural gas price:								
Modified NGPA	275.1	318.9	378.4	468.0	575.2	633.9	692.8	757.4
Price freeze	272.7	275.1	277.6	318.9	413.9	535.2	684.8	750.2
Accelerated decontrol	279.2	342.6	549.4	553.9	620.0	681.3	744.6	809.2

Source: Wharton Econometric Forecasting Associates, 1983.

compared by discounting real GNP over the 1983-92 period using the short-term interest rates determined within the Wharton model. The time period of comparison is extended to 1992 to allow each deregulation policy to achieve equilibrium.

The total of undiscounted GNP over the period 1983-92 is \$17.811 trillion for the modified NGPA, \$17.817 trillion for the price freeze, and \$17.788 trillion for the accelerated decontrol option. About \$29 billion separates the accelerated decontrol GNP from the price freeze GNP. The value of real GNP would be \$14.262 trillion for accelerated decontrol, \$14.383 trillion for the price freeze, and \$14.329 trillion for the modified NGPA option. After discounting, the difference between the GNP value in any given year for the price freeze and accelerated decontrol is \$121 billion or less than 1 percent.

Agricultural Effects

The gas-price trajectories are the key to the differences in agricultural effects and to the conclusions of this study. The gas-price trajectories specified by Wharton are quite similar to those obtained in a DOE analysis for gas-pricing policies.¹⁵ An important conclusion of the DOE analysis is that natural gas prices will continue to rise after decontrol. By 1985, the price differences between policy options are large. The difference between the average industrial gas price for the accelerated decontrol and modified NGPA options would be 43 percent; between accelerated decontrol and the price freeze option it would be 91 percent. These differences, however, would fall to less than 10 percent by 1990.

Since the cost of natural gas comprises approximately 70 percent of the variable costs of producing ammonia for nitrogenous fertilizer, major increases in natural gas prices will significantly increase fertilizer prices. However, because of the potential moderating effect of fertilizer imports, aggregate fertilizer prices would differ at most by 19 percent in 1985 and only 2 percent by 1990 (table 3).

In 1985, total fertilizer imports would be 12 percent higher with accelerated decontrol than with the modi-

fied NGPA option. Gas prices would converge by 1990 and the difference between fertilizer imports under accelerated decontrol and modified NGPA diminishes to only 2 percent. Thus, fertilizer imports readily substitute for domestic fertilizer production, placing downward pressure on fertilizer prices. Fertilizer imports would increase in all three policy options although at different rates. This increase in imports would moderate the rise in fertilizer prices and agricultural costs of production. The effects of accelerated decontrol on the costs of agricultural production would be greater if fertilizer import quotas are imposed.

Agricultural Output, Prices, and Harvested Acres

Differences in crop production in 1985 and 1990 would generally be less than 1 percent across the deregulation policy options considered (table 3).¹⁶ Percentage differences in prices and acreage harvested are also small. Wheat, corn, and soybean prices would be, respectively, 1.3, 0.7, and 1.5 percent higher in 1985 for the accelerated decontrol relative to modified NGPA. Cotton prices would be the same in those two options. By 1990, price differences would still be small. Differences in harvested acreage of food grains and feed grains would generally be less than 2 percent under accelerated decontrol relative to modified NGPA. The small changes in fertilizer prices for all three price policy options would elicit little response in production, agricultural prices, or harvested acres. With higher fertilizer prices, there would be a slight alteration in the crop mix away from fertilizer-intensive cotton, food grain, and feed grain production toward soybean production. However, this effect is small and limited to the near term. Soybean production under accelerated decontrol would increase by 0.4 percent in 1985 relative to the modified NGPA option.

Net Farm Income

Deregulation policy would have small effects on net farm income (table 4). The largest economic effects would occur in the near term. In 1985, net farm income under accelerated decontrol would be nearly 4 percent lower than under the modified NGPA or price freeze policy options. This difference between accelerated decontrol and modified NGPA would

¹⁵U.S. Department of Energy, Energy Information Administration. *Analysis of the Natural Gas Policy Act and Several Alternatives*, Part IV. DOE/EIA-0366 (83/05). May 1983.

¹⁶More detailed information than that contained in table 3 is provided in app. F.

Table 3—Effects of alternative natural gas-pricing policies on selected agricultural variables

Variable	Unit	1982	1985			1990		
			Modified NGPA	Accel. decontrol	Price freeze	Modified NGPA	Accel. decontrol	Price freeze
Fertilizer indicators:								
Aggregate fertilizer price	1967 = 1.0	2.62	3.60	3.98	3.33	4.53	4.62	4.47
Industrial natural gas price	Dollars per 1,000 cubic feet	3.60	5.69	8.13	4.25	11.08	11.94	10.71
Fertilizer imports	1,000 tons	8,680.00	10,174.00	11,409.00	9,265.00	12,717.00	13,024.00	12,579.00
Production:								
Wheat	Million bushels	2,840.0	2,615.0	2,602.0	26,220.0	2,818.0	2,818.0	2,825.0
Corn	do.	8,615.0	8,166.0	8,120.0	8,179.0	9,139.0	9,139.0	9,092.0
Sorghum	do.	824.0	818.0	809.0	824.0	823.0	821.0	813.0
Soybeans	do.	2,199.0	2,308.0	2,316.0	2,303.0	2,627.0	2,615.0	2,611.0
Cotton	Million bales	12.1	11.4	11.0	11.3	11.0	10.9	10.7
Prices received:								
Wheat	Dollars per bushel	3.45	3.82	3.87	3.81	4.67	4.69	4.66
Corn	do.	2.55	2.81	2.83	2.80	3.89	3.94	3.94
Sorghum	do.	2.30	2.70	2.74	2.88	3.71	3.71	3.33
Soybeans	do.	5.83	6.64	5.56	6.67	12.02	12.19	12.31
Cotton	Dollars per hundredweight	57.10	66.70	66.70	66.70	89.25	93.00	95.31
Acres harvested:								
Wheat	Million acres	77.80	67.70	67.30	67.90	68.10	68.00	68.40
Corn	do.	80.70	80.90	80.70	81.00	86.40	86.60	86.50
Soybeans	do.	15.30	14.70	14.50	14.80	14.20	14.10	14.00
Cotton	do.	9.20	12.20	12.20	10.80	10.90	10.90	11.10
Variable costs of production:								
Wheat	Million dollars	4,923	5,326	5,503	5,196	7,144	7,187	7,141
Corn	do.	12,259	15,402	16,104	14,894	21,579	21,830	21,483
Sorghum	do.	1,191	1,435	1,462	1,412	1,877	1,875	1,842
Soybeans	do.	5,707	7,072	7,282	6,941	10,255	10,282	10,187
Cotton	do.	2,407	3,906	3,991	3,850	4,637	4,703	4,747
Government payments:								
Government deficiency payments	do.	872	3,031	2,844	3,159	536	503	545
Government storage payments	do.	884	798	773	827	752	673	730
Government dairy payments	do.	2,050	288	268	331	1,921	1,675	2,004
Total Government payments	do.	3,806	4,177	3,886	4,316	3,209	2,852	3,279
Farm income statistics:								
Receipts from livestock	Billion dollars	76	88	89	87	116	116	115
Receipts from crops	do.	73	82	82	82	118	118	118
Total market receipts	do.	149	170	170	169	233	234	233
Deficiency payments	do.	1	3	3	3	1	1	1
Other income	do.	19	23	23	23	25	25	25
Gross farm income	do.	167	196	196	192	258	259	258
Total farm expenses	do.	168	167	168	166	231	232	232
Net farm income	do.	23	29	28	29	27	27	25
Total net income	do.	21	29	28	29	27	27	25

¹Less than \$1 billion.

Agricultural Implications of Natural Gas Deregulation

decrease to nearly zero by 1990. Net farm income in 1990 under the price freeze would be about 6 percent lower than under accelerated decontrol or modified NGPA.

The differences in the sum of net farm income from 1983 to 1990, where income has been deflated by the GNP implicit price deflator, would be \$2.1 billion between accelerated decontrol and modified NGPA and \$0.02 billion between accelerated decontrol and the price freeze option. Since the timepaths of farm income differ among the alternative natural gas policy options considered, net farm income is a better measure of the differential policy impacts than a simple sum. Projections of real net farm income under each policy option are compared in table 5. These figures are calculated using a 4-percent real discount rate (10 percent nominal).

Relative to accelerated decontrol, net farm income would be \$2.8 billion higher for the modified NGPA and \$2.1 billion higher for the price freeze. The negative effects on net farm income under accelerated decontrol would be caused by increases in natural gas and fertilizer prices and adverse macroeconomic conditions. During most of the early years of the 1983-90 period, food demand would be lower and farm production expenditures would be higher for accelerated decontrol than for the other two options even though farm production expenses would be highest under modified NGPA. Food demand would be lower because real disposable income would be lower under the accelerated decontrol option. Generally higher natural gas prices, fertilizer prices, hourly wages, and interest rates under accelerated decontrol would cause higher farm production expenditures. Variable costs of production for food grains and feed grains would be 1 to 5 percent higher for accelerated decontrol than for modified NGPA or price freeze. Total production costs would be 1 percent higher in 1985 and 0.5 percent higher in 1990 under accelerated decontrol than under modified NGPA. Accelerated decontrol would result in lower discounted net farm income than the other options.

Government Payments

Under the modified NGPA and price freeze policy options, total Government payments to farmers would be \$1.2 billion (6 percent) and \$1.8 billion (8 percent)

higher, respectively, than under accelerated decontrol (table 6). The payment-in-kind (PIK) program would not be extended beyond 1983 in this simulation.

Table 4—Simulated net farm income under alternative natural gas-pricing policy options¹

Year	Modified NGPA	Accelerated decontrol	Price freeze
<i>Billion dollars</i>			
1983	25.6	25.6	26.1
1984	21.0	20.9	21.4
1985	26.0	25.0	26.0
1986	23.0	22.3	22.9
1987	24.4	24.0	23.9
1988	25.2	24.8	24.3
1989	25.6	25.5	24.3
1990	26.8	26.8	25.3

¹Excludes Government payments.

Table 5—Projected farm expenditures and income by policy option, 1983-90

Farm income and expenditures	Modified NGPA	Accelerated decontrol	Price freeze
<i>Billions of 1982 dollars</i>			
Livestock receipts	574.4	573.7	575.6
Crop receipts	547.0	545.3	552.2
Total receipts	1,121.3	1,119.1	1,127.6
Other income	133.7	132.5	134.8
Gross farm income	1,255.0	1,251.6	1,262.4
Total farm expenses	1,102.8	1,102.3	1,110.9
Net farm income	152.2	149.4	151.5
Change in farm inventory	-1.2	-1.2	-1.1
Total net farm income	150.0	148.0	150.9

Table 6—Present value of Government payments to agriculture, 1983-90

Farm income and expenditures	Modified NGPA	Accelerated decontrol	Price freeze
<i>Billions of 1982 dollars</i>			
Government deficiency payments	11.1	10.5	11.3
Government storage payments	5.1	5.0	5.3
Government dairy payments	6.8	6.3	7.0
Total Government payments	23.0	21.8	23.6

Thus, while the modified NGPA and price freeze policies would generate about a 2-percent increase in net farm income, total Government payments would be 6 and 8 percent larger, respectively, than with accelerated decontrol. Therefore, if accelerated decontrol of natural gas is rejected as a policy, then Government payments and net farm income to agriculture will be higher compared with the modified NGPA or price freeze policy options.

Conclusions

Accelerated decontrol of natural gas prices will probably have a small effect on the agricultural sector. Only modest fertilizer price increases will result even for large increases in natural gas prices due to the potential moderating influence of fertilizer imports. Increases in agricultural production costs should be

small. Higher natural gas prices would have only a small negative effect on real disposable income and, therefore, a small negative effect on the demand for food.

Under accelerated decontrol, the present value of net farm income for 1983–90 is estimated to be about \$2.8 billion (1982 dollars) less and total Government payments to farmers for farm program participation would be \$1.2 billion less than under modified NGPA. While gas and fertilizer prices would not rise as rapidly with the price freeze and modified NGPA, these prices would increase rapidly after 1985. Under either modified NGPA or the price freeze options, net farm income would be slightly greater than under the accelerated decontrol. However, the difference in net farm income between the price freeze option and the accelerated decontrol option would be less than \$1 billion.

Appendix A: Reduced-Form Model of Fertilizer Prices and Imports

Fertilizer prices and fertilizer import quantities will probably change with changes in natural gas prices paid by domestic fertilizer producers. As natural gas prices increase, for example, the domestic supply of fertilizer is likely to decrease, but imports are likely to increase. The net result of such a stimulus should be to raise fertilizer prices, assuming agricultural production remains constant. The effects of natural gas price changes on aggregate fertilizer prices and fertilizer import levels were determined using a simple two-equation econometric model. In time period "t" the price of fertilizer (F) is specified to be a log-linear function of natural gas prices (G), fertilizer import quantities (I), and agricultural output (Q). Imports of fertilizer in this time period are expressed as a log-linear function of natural gas prices paid by domestic fertilizer producers and fertilizer prices. The fertilizer price equation (1) and associated statistics are:

$$F_t = 6.18 + 0.34G_t + 0.89Q_t - 0.20I_t \quad (1)$$

(1.33) (0.11) (0.42) (0.15)

$\bar{R}^2 = 0.89$
DW = 1.35

Equation (1) is estimated from aggregate time series data for 17 years using the instrumental-variable technique. Because of the presence of serial correlation in the import equation, a mixed estimator (Corchrane-Orcutt and instrumental variables) is employed to estimate equation (2):

$$I_t = 7.89(1 - \rho) + 0.16(F_t - \rho F_{t-1}) \quad (2)$$

(1.08) (0.24)

$$+ 0.28(G_t - \rho G_{t-1}) + \rho I_{t-1}$$

(0.13)

where $\rho = 0.62$
(0.20)

$\bar{R}^2 = 0.96$
DW = 2.84

Equations (1) and (2) were used to project the fertilizer prices and import quantities that appear in text table 3.

The FAPSIM, WHARTON, and reduced-form models were linked in a simple recursive fashion. Fertilizer-price trajectories were obtained by substituting the alternative natural gas-price trajectories specified by WHARTON in the reduced-form model. Agricultural output projections in the reduced-form model conform to historical trends. Nominal fertilizer-price trajectories for the alternative gas policies were used to determine fertilizer expenditure per acre for selected crops and to modify crop yields. Nonfertilizer expenditures per acre were determined for given labor and interest costs and the GNP deflator specific to each WHARTON policy. Changes in the overall variable cost per acre, which appear in the acres-planted equations in FAPSIM, were constructed from projections obtained in each of the other modeling systems. Irrigation or grain-drying costs were assumed to remain constant. The demand component of FAPSIM was adjusted for the disposable personal income for each gas-price policy. No feedback loops were used because the initial results of the FAPSIM solution differed only slightly in the agricultural quantities produced across policies and conformed to policies' historical trends used in the initial phase of the reduced-form model.

Appendix B: Simulated Crop Production for Alternative Natural Gas-Pricing Policy Options: 1982-90

Appendix table 1—Accelerated decontrol

Output	Unit	1982	1983	1984	1985	1986	1987	1988	1989	1990
Wheat	Million bushels	2,840.6	2,557.1	2,592.9	2,601.5	2,627.0	2,700.7	2,728.9	2,775.8	2,813.0
Corn	do.	8,614.6	7,239.3	8,169.5	8,120.2	8,378.8	8,459.6	8,783.1	8,822.2	9,133.1
Sorghum	do.	823.5	715.9	884.3	809.2	850.6	831.5	867.2	835.7	820.6
Barley	do.	491.2	461.7	463.2	451.0	454.2	442.0	465.2	469.1	468.7
Oats	do.	555.4	523.1	508.5	482.8	470.1	454.0	446.8	432.7	421.3
Soybeans	do.	2,199.0	2,206.6	2,268.1	2,316.8	2,324.2	2,417.1	2,456.7	2,561.8	2,615.0
Cotton	Million bales	12.1	9.6	10.7	11.0	10.9	11.0	11.5	11.1	10.9
Beef	Billion pounds	23.3	24.1	24.1	25.3	26.0	26.5	27.3	28.0	28.6
Pork	do.	14.6	15.1	16.0	15.8	16.0	16.1	16.2	16.1	16.0
Fluid milk	do.	135.5	137.0	136.6	137.8	139.9	141.8	142.8	143.8	144.8

Appendix table 2—Price freeze

Output	Unit	1982	1983	1984	1985	1986	1987	1988	1989	1990
Wheat	Million bushels	2,840.6	2,558.4	2,600.1	2,621.7	2,644.5	2,720.4	2,738.9	2,790.9	2,825.2
Corn	do.	8,614.6	7,253.8	8,205.4	8,178.8	8,371.8	8,457.5	8,769.9	8,806.4	9,092.1
Sorghum	do.	823.5	716.5	886.6	823.8	842.8	835.1	865.1	834.6	813.1
Barley	do.	491.2	462.3	462.6	450.3	453.6	441.0	464.5	467.3	468.0
Oats	do.	555.4	526.4	512.7	485.2	468.1	451.6	443.9	428.6	417.4
Soybeans	do.	2,199.0	2,208.1	2,265.2	2,302.8	2,322.5	2,417.3	2,458.9	2,535.8	2,611.2
Cotton	Million bales	12.1	9.6	11.0	11.3	11.1	10.6	10.9	11.2	10.7
Beef	Billion pounds	23.3	24.1	24.1	25.2	26.0	26.5	27.2	28.0	28.5
Pork	do.	14.6	15.1	16.0	15.8	16.0	16.1	16.1	16.0	16.0
Fluid milk	do.	135.5	137.0	136.7	138.0	140.2	142.2	143.3	144.4	145.5

Appendix table 3—Modified NGPA

Output	Unit	1982	1983	1984	1985	1986	1987	1988	1989	1990
Wheat	Million bushels	2,840.6	2,558.1	2,596.4	2,614.5	2,634.0	2,709.5	2,731.5	2,781.6	2,817.9
Corn	do.	8,614.6	7,243.2	8,180.2	8,166.1	8,385.1	8,470.8	8,803.0	8,866.6	9,138.5
Sorghum	do.	823.5	716.6	885.2	818.4	843.7	834.2	868.3	838.1	823.3
Barley	do.	491.2	461.7	462.8	450.7	454.9	441.2	465.2	468.8	468.6
Oats	do.	555.4	523.5	509.5	486.3	471.5	455.0	448.7	434.2	423.6
Soybeans	do.	2,199.0	2,206.1	2,266.6	2,308.4	2,327.8	2,421.6	2,464.3	2,550.0	2,627.1
Cotton	Million bales	12.1	9.6	10.8	11.4	11.2	10.9	11.2	11.3	11.0
Beef	Billion pounds	23.3	24.1	24.1	25.3	26.0	26.5	27.2	28.0	28.6
Pork	do.	14.6	15.1	16.0	15.8	16.0	16.1	16.2	16.1	16.1
Fluid milk	do.	135.5	137.0	136.6	137.9	140.0	142.0	143.2	144.4	145.5

Appendix C: Simulated Crop Prices for Alternative Natural Gas-Pricing Policy Options: 1982-90

Appendix table 4—Accelerated decontrol

Output	Unit	1982	1983	1984	1985	1986	1987	1988	1989	1990
Wheat	Dollars per bushel	3.45	3.65	3.73	3.87	4.27	4.31	4.46	4.57	4.69
Corn	do.	2.55	2.98	2.65	2.83	2.98	3.35	3.48	3.79	3.94
Sorghum	do.	2.30	2.91	2.52	2.74	2.92	3.35	3.44	3.60	3.71
Barley	do.	2.30	2.50	2.30	2.50	2.60	2.90	2.90	3.10	3.20
Oats	do.	1.68	1.81	1.78	1.91	2.09	2.33	2.50	2.71	2.90
Soybeans	do.	5.83	6.52	6.54	6.56	7.67	8.61	10.00	10.90	12.19
Cotton	Dollars per hundredweight	57.10	55.00	65.00	66.70	72.90	84.20	84.60	86.90	93.00
Fluid milk	do.	13.69	12.94	12.97	14.12	15.32	16.49	17.63	18.80	19.95
Beef	1967 = 1.0	2.74	2.89	3.09	3.17	3.40	3.60	3.74	3.80	3.92
Pork	do.	2.81	2.85	2.88	3.09	3.25	3.46	3.65	3.85	4.05

Appendix table 5—Price freeze

Output	Unit	1982	1983	1984	1985	1986	1987	1988	1989	1990
Wheat	Dollars per bushel	3.45	3.65	3.71	3.81	4.23	4.25	4.42	4.53	4.66
Corn	do.	2.55	2.96	2.65	2.80	2.98	3.34	3.45	3.81	3.94
Sorghum	do.	2.60	2.72	2.88	2.88	2.97	3.06	3.15	3.24	3.33
Barley	do.	2.32	2.45	2.31	2.47	2.60	2.90	2.91	3.19	3.29
Oats	do.	1.68	1.79	1.76	1.88	2.09	2.33	2.50	2.74	2.93
Soybeans	do.	5.83	6.48	6.48	6.67	7.73	8.64	9.93	11.18	12.31
Cotton	Dollars per hundredweight	57.10	55.00	63.84	66.70	68.43	79.15	89.34	89.38	95.31
Fluid milk	do.	13.69	12.94	12.97	14.10	15.32	16.49	17.63	18.80	19.94
Beef	1967 = 1.0	2.74	2.89	3.07	3.12	3.33	3.53	3.68	3.74	3.89
Pork	do.	2.81	2.86	2.86	3.04	3.21	3.41	3.61	3.81	4.02

Appendix table 6—Modified NGPA

Output	Unit	1982	1983	1984	1985	1986	1987	1988	1989	1990
Wheat	Dollars per bushel	3.45	3.65	3.72	3.82	4.26	4.28	4.45	4.55	4.67
Corn	do.	2.55	2.97	2.65	2.81	2.96	3.32	3.41	3.74	3.89
Sorghum	do.	2.30	2.90	2.52	2.70	2.92	3.31	3.38	3.60	3.71
Barley	do.	2.60	2.60	2.60	2.60	2.70	2.80	2.80	2.90	3.00
Oats	do.	1.68	1.80	1.77	1.89	2.08	2.32	2.47	2.69	2.88
Soybeans	do.	5.83	6.51	6.50	6.64	7.66	8.55	9.80	10.96	12.02
Cotton	Dollars per hundredweight	57.10	55.00	65.00	66.70	68.42	77.06	83.84	84.19	89.25
Fluid milk	do.	13.69	12.94	12.97	14.12	15.32	16.49	17.63	18.80	19.94
Beef	1967 = 1.0	2.74	2.89	3.08	3.14	3.37	3.58	3.72	3.77	3.91
Pork	do.	2.81	2.85	2.87	3.06	3.23	3.44	3.63	3.82	4.02

Appendix D: Simulated Variable Costs of Crop Production for Alternative Natural Gas-Pricing Policy Options: 1982-90

Appendix table 7—Accelerated decontrol

Output	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Million dollars</i>									
Wheat	4,923.41	3,550.05	5,036.79	5,502.84	5,778.98	6,210.39	6,507.10	6,861.16	7,187.41
Corn	12,258.51	8,760.44	14,711.74	16,104.18	17,137.29	17,981.86	19,545.98	20,517.46	21,829.76
Sorghum	1,191.14	871.89	1,462.42	1,461.54	1,600.96	1,643.98	1,817.76	1,848.36	1,875.35
Barley	617.88	640.34	708.23	750.79	789.50	808.36	883.35	928.44	951.66
Oats	567.19	571.41	608.67	645.12	666.09	676.28	687.87	696.89	704.32
Soybeans	5,707.27	5,918.25	6,543.27	7,282.06	7,722.15	8,443.16	8,943.84	9,689.82	10,282.04
Cotton	2,406.98	2,148.72	3,578.59	3,990.69	4,191.99	4,304.19	4,573.20	4,601.57	4,702.83

Appendix table 8—Price freeze

Output	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Million dollars</i>									
Wheat	4,923.41	3,542.73	4,948.72	5,196.37	5,512.69	6,003.13	6,343.18	6,808.76	7,141.00
Corn	12,258.51	8,737.48	14,340.17	14,893.62	16,009.07	17,044.52	18,851.15	20,200.39	21,482.87
Sorghum	1,191.14	870.39	1,437.57	1,411.59	1,519.40	1,594.97	1,760.41	1,824.19	1,841.68
Barley	617.88	639.18	687.79	708.57	752.86	777.66	860.25	904.82	940.68
Oats	567.19	570.57	599.78	614.85	632.58	646.24	672.08	688.16	696.80
Soybeans	5,707.27	5,911.23	6,448.01	6,940.50	7,451.09	8,197.41	8,772.34	9,494.03	10,186.71
Cotton	2,406.98	2,146.37	3,540.87	3,850.06	4,063.37	4,152.04	4,408.43	4,754.49	4,745.63

Appendix table 9—Modified NCPA

Output	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Million dollars</i>									
Wheat	4,923.41	3,546.15	5,008.39	5,325.89	5,681.19	6,164.93	6,449.51	6,807.97	7,144.22
Corn	12,258.51	8,748.03	14,567.72	15,402.22	16,721.21	17,726.23	19,309.34	20,357.89	21,578.48
Sorghum	1,191.14	871.13	1,453.88	1,434.73	1,563.98	1,639.30	1,802.12	1,833.67	1,876.14
Barley	617.88	639.75	696.04	726.01	776.18	800.44	875.54	909.71	944.96
Oats	567.19	571.01	604.64	627.25	648.83	662.30	682.53	691.75	699.84
Soybeans	5,707.27	5,907.10	6,507.27	7,071.71	7,616.59	8,367.96	8,890.86	9,566.31	10,255.26
Cotton	2,406.98	2,147.96	3,566.02	3,906.32	4,140.60	4,232.72	4,426.44	4,614.86	4,636.52

Appendix E: Simulated Government Payments for Alternative Natural Gas-Pricing Policy Options: 1982-90

Appendix table 10—Accelerated decontrol

Government payments	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Million dollars</i>									
Deficiency payments	872.1	2,073.4	3,837.4	2,843.9	1,910.6	795.4	551.6	583.3	503.4
Storage payments	884.0	857.3	662.8	773.4	818.0	824.5	807.8	760.8	673.2
Dairy payments	2,049.5	797.7	186.6	268.4	766.5	977.9	1,148.4	1,359.9	1,675.0
Total Government payments	3,805.6	3,728.4	4,686.8	3,885.7	3,495.1	2,597.8	2,507.8	2,659.0	2,851.6

Appendix table 11—Price freeze

Government payments	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Million dollars</i>									
Deficiency payments	872.1	2,075.0	3,866.4	3,159.0	2,054.3	1,127.2	602.2	582.2	544.8
Storage payments	884.0	858.7	668.3	825.7	876.8	887.5	877.5	829.0	730.3
Dairy payments	2,049.5	774.9	210.4	331.3	847.7	1,102.0	1,349.1	1,674.1	2,003.5
Total Government payments	3,805.6	3,708.5	4,765.1	4,316.0	3,778.9	3,116.7	2,828.9	3,085.3	3,278.6

Appendix table 12—Modified NGPA

Government payments	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Million dollars</i>									
Deficiency payments	872.1	2,074.0	3,838.2	3,030.6	2,073.0	1,134.4	616.2	573.5	536.4
Storage payments	884.0	858.8	674.6	798.2	848.1	860.0	853.7	820.8	751.7
Dairy payments	2,049.5	804.9	199.1	287.7	816.8	1,053.0	1,273.8	1,578.8	1,920.7
Total Government payments	3,805.6	3,737.7	4,711.9	4,166.5	3,737.9	3,047.4	2,743.7	2,973.1	3,208.8

Appendix F: Simulated Farm Income and Expenses for Alternative Natural Gas-Pricing Policy Options: 1982-90

Appendix table 13—Accelerated decontrol

Farm income and expenditures	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Billion dollars</i>									
Receipts from livestock	76.1	80.3	82.4	88.7	93.1	101.4	107.2	111.2	116.0
Receipts from crops	72.7	74.1	78.5	81.7	87.1	94.4	102.5	110.1	118.0
Total market receipts	148.8	154.5	160.9	170.4	181.3	195.8	209.7	221.3	234.0
Other income	18.6	17.8	19.8	23.0	22.9	22.9	22.7	23.5	24.6
Gross farm income	167.4	172.3	180.7	193.4	204.2	218.6	232.4	244.8	258.6
Total farm expenses	144.8	146.6	159.8	168.4	182.0	194.7	207.6	219.3	231.9
Net farm income	22.6	25.6	20.9	25.0	22.3	24.0	24.8	25.5	26.8
Change in farm inventory	-1.8	.7	-.8	.4	-.2	.7	0	.1	.1
Total net income	20.8	26.3	20.1	25.4	22.0	24.7	24.8	25.7	26.9

Appendix table 14—Price freeze

Farm income and expenditures	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Billion dollars</i>									
Receipts from livestock	76.1	80.5	81.9	87.3	92.8	99.9	105.5	109.5	114.5
Receipts from crops	72.8	74.1	78.4	81.8	87.1	94.1	102.2	110.2	118.4
Total market receipts	148.8	154.6	160.3	169.0	179.8	193.9	207.7	219.6	232.9
Other income	18.6	17.8	19.8	23.0	23.2	23.0	23.1	23.6	24.7
Gross farm income	167.4	172.4	180.1	192.0	203.1	217.0	230.7	243.2	257.6
Total farm expenses	144.8	146.3	158.7	166.1	180.2	193.0	206.4	219.0	232.3
Net farm income	22.6	26.1	21.4	26.0	22.9	23.9	24.3	24.3	25.3
Change in farm inventory	-1.8	.7	-.9	.4	-.2	.7	0	.2	.1
Total net income	20.8	26.8	20.5	26.4	22.6	24.6	24.3	24.4	25.4

Appendix table 15—Modified NGPA

Farm income and expenditures	1982	1983	1984	1985	1986	1987	1988	1989	1990
<i>Billion dollars</i>									
Receipts from livestock	76.1	80.3	82.2	88.0	93.5	100.9	106.6	110.5	115.5
Receipts from crops	72.7	74.1	78.5	81.8	87.1	93.9	101.8	109.5	117.5
Total market receipts	148.8	154.4	160.7	169.8	180.6	194.8	208.4	219.9	233.0
Other income	18.6	17.8	19.8	23.0	23.1	23.0	23.1	23.6	24.7
Gross farm income	167.4	172.2	180.5	192.7	203.7	217.9	231.5	243.5	257.6
Total farm expenses	144.8	146.6	159.4	166.7	180.7	193.4	206.2	217.9	230.8
Net farm income	22.6	25.6	21.0	26.0	23.0	24.4	25.2	25.6	26.8
Change in farm inventory	-1.8	.7	-.8	.4	-.2	.7	0	.1	.1
Total net income	20.8	26.3	20.2	26.4	22.8	25.1	25.2	25.7	27.0

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